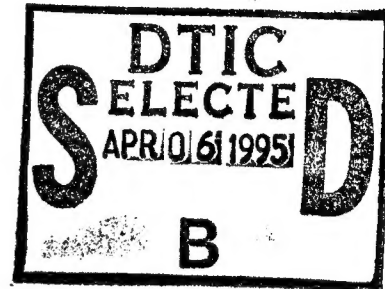


AOARD REPORT

Center for Advanced Aerospace Materials (CAAM), Seoul
National University, 29 June 1994

29 June 1994
P. McQuay
AOARD



This report summarizes discussions held with eight members of the newly organized Center for Advanced Aerospace Materials, which is supported by the Korea Science and Engineering Foundation. Although the majority of projects at the center do fall under the broad category of aerospace materials, some of the work is also aimed at the application of traditional aerospace materials to automotive and other applications. The largest amount of research is based on Al alloys such as the 7000 series, Al-Li alloys, and RS Al alloys. Of note among this work is a high strength and weldable Mn-modified Al-Zn-Mg alloy which is being developed for commercialization. Other work of interest includes elemental PM-based gamma Ti-Al alloys, AlN fibers, whiskers and foams produced by SHS, and theoretical advancements in SPF.

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2. OVERVIEW AND BACKGROUND

CAAM was organized in 1991 as an inter-university engineering research center in the area of R&D of advanced aerospace materials. It is the fourth Engineering Research Center (ERC) sponsored by the Korea Science and Engineering Foundation, which is comparable to the US National Science Foundation. The other 3 ERC's are Thin-Film Crystal Growth, Interfaces, and Rapid Solidification Technology.

The largest number of researchers are from Pohang Institute of Science and Technology (a.k.a. POSTECH), which is also the headquarters for the center. Other members are professors at other major Korean universities or research institutes, and are given in Appendix 1. In total, as of Jun 94, there were 24 faculty members from 13 institutions.

CAAM is divided into four major areas of aerospace materials research:

1. Light Weight Metals - Al and Al-Li Alloys, Mg Alloys and Be Alloys
2. High Temperature/High Strength Materials - High Temperature Al Alloys, Ti Alloys, Intermetallics, Superalloys and Refractory Alloys
3. Composite Materials - Compocast Composites, Squeeze Cast Composites, PM Composites, and Functionally Graded Composites
4. Process Development/Characterization - Joining, Coating, Superplastic Forming, Forging/Rolling/Extrusion, and Powder Metallurgy

There is also emphasis at CAAM to apply these aerospace materials to automotive applications. A CAAM workshop with the theme "Light Weight Materials for Vehicles," was held in June of 1993.

The research budget for CAAM is approximately \$750K per year. At first glance this seems like a small research budget for such a large staff. However, the relative buying power of the \$ in Korea is higher than in the US (meaning more bang for the buck), and the operating funds for the center staff are provided through each of their respective institutes, provided by the Korea Ministry of Education.

3. DISCUSSIONS WITH CAAM MEMBERS, SEOUL NATIONAL UNIVERSITY, 29 JUNE 1994

Dr. Shiro Fujishiro and myself visited Seoul National University on 29 June 1994, to meet with the some of the members of the Center for Advanced Aerospace Materials (CAAM), upon invitation of the center director:

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 Director, CAAM
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 San 31, Hyojandong
 Pohang 790-784
 Korea
 Tel/Fax: +82 (562) 279-2135/2399
 email: mjkim@vision.postech.ac.kr

Our host at Seoul National University was:

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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
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In addition to Prof Kim and Prof Shin, six other members of CAAM participated in the discussions. Dr. Fujishiro and myself each gave a brief introduction to AOARD, and I gave a brief introduction to AOARD programs. Following these remarks, all of the present members gave a 15 to 30 minute presentation on their current research projects and interests. They are summarized below.

Prof Nak J. Kim's interests are in light weight metals such as Al and Mg, and has also done some work on Ti-based materials, including TiAl. Dr. Kim worked at Allied Signal for four years on rapidly solidified Al and Al composites, and has continued similar work in Korea. Some titles of current research projects include: "Development of Low Density Al-Li Alloys with Improved Ductility," "New Aspects on the Superplasticity of Fine-Grained 7475 Al Alloys," "Microstructure and Mechanical Properties of Al-Li Alloys," "Structure and Properties of Mg Alloys," "Rapidly Solidified Al Based Alloys," "Fabrication of Mg Alloy Automobile Parts," "Development of High Temperature Al Alloys by RSP/PM", and "Tough TiAl Alloys for High Temperature Application." Dr. Kim is on the Editorial Board of professional journals, including *Acta Metall.*

Prof Kwang Seon Shin, our host at the meeting, also has interest in fatigue and creep studies, microstructure-mechanical properties of various alloy systems including high strength Al and Al-Li alloys, Mg alloys, high strength steel, Mo₂Si and W alloys. His work on W alloys is primarily for nuclear applications.

Prof Soo Woo Nam is a member of KAIST, one of the premier graduate schools in Korea. His research interests include the deformation mechanisms of cyclical creep, low cycle fatigue, creep fatigue interactions, life prediction of materials under fatigue, and alloy development of low density and high strength alloys. He has developed a new Mn-modified Al-Zn-Mg alloy, based on the 7000 series of Al alloys, which reportedly has good weldability, better strength than 7017 and 7075, with decreased quench sensitivity compared to 7075. He currently has a government sponsored Highly Advanced National (HAN) project, to develop and market the alloy.

Prof Sun Deun Hwang is a professor at Inha University, in Incheon. His research interests are almost strictly in the area of high temperature alloys: Ni-based superalloys, intermetallics, and Zircalloys. Most of his current work emphasizes powder metallurgy and mechanical alloying approaches. He has also conducted reactive-extrusion of elemental Ti and Al powders to fabricate gamma TiAl alloys. He reports good results, with homogeneous and fine microstructures, and tensile elongations of up to 4%.

Prof Sunghak Lee is an associate professor at POSTECH. His main interests center around dynamic fracture behavior, primarily aimed at ballistic applications. It goes without saying that much of his research is funded by the Korean Agency for Defense Development. His other interests include processing and evaluation of SiC whisker and particulate reinforced Al composites, the fracture mechanics of high temperature Al alloys and Al-Li alloys, and the fracture toughness analysis of HSLA Steel welds.

Prof Young Won Chang is the current Division Head for Metallic Materials at POSTECH, and also leads a group on Super Plastic Forming (SPF) for CAAM. He is developing a comprehensive physical model to describe SPF, and new SPF processes for aerospace materials. The new model depends heavily on dislocation kinetics which are necessary for grain deformation, grain boundary sliding and rotation, given a given set of microstructural features, and processing parameters such as temperature and strain rate.

A recent member of the CAAM faculty is an Assistant Professor from Hong Ik University, Prof Yong-Seog Kim. His primary activity is research into SHS processing of intermetallics, and ceramics based on borides, hydrides, nitrides, carbonitrides, and silicides. Of interest are the various morphologies of AlN which he has produced in a proprietary SHS process, which can yield foams, whiskers, fibers or complex three-dimensional structures depending on the processing variables.

The last member of CAAM to participate in the meeting was Dr. Sangho Ahn, who is the Head of the Metallic Materials Division of the Research Institute of Industrial Science and Technology (RIST), the corporate research laboratory of Pohang Steel Co. Dr. Ahn did not give a presentation outlining his research, but informal mentioned his interests in PM and spray forming and casting of TiAl and Cu-based alloys.

A short CV, list of publications, and a brief description of the projects for each of the CAAM research members is available upon request.

4. SUMMARY AND COMMENTS

CAAM may be an outgrowth of several perceived needs in the ongoing development of the S&T infrastructure in Korea. First, continuing emphasis and support from the Korean government to foster high technology. Certainly one of the quickest and most efficient methods for a government organization to increase funding in a given area is to encourage establishment of an organization such as CAAM, and then to empower the organization to establish its own priorities, goals and objectives with the funding it provides. This is especially true in basic science, where the value of the grants is low, and the number of grants are high. Second, a need perceived by members of the Korean materials community to develop an organization performing basic research on aerospace materials to provide a more collaborative and cooperative organization with a critical mass. CAAM seems to accomplish both of these goals well.

One potential concern is that the organization and its goals appear to be diverse and diffuse, with a relatively low level of funding. It is not known whether there is significant direction or oversight from either internal or government management, or how well these research projects are tied to industry needs and interests. This would seem to be especially important in light of the supposedly focused purpose of the center's activities.

Overall, the center appears to have a very competent research staff. It is interesting to note the very high percentage of professionals we met that received their advanced degrees from some of the finest US and European universities. There is also a very high percentage which performed post-doctoral or sabbatical research at major Western universities or research institutions. Therefore, not only is their level of competence high, they also have good contacts in the US and Europe.

This time honored tradition of studying and training abroad appears now to be in decline. As the quality of Korean research and educational institutions increases, there is move afoot by the Korean academic community to keep more of their best and brightest to be trained at Korean universities and institutes.

APPENDIX 1

CAAM Faculty

Changwon National University: Kwon, D.I.

Choongbook National University: Hong, J.W.

Dong-A University: Lee, S.K.

Hankuk Aviation University: Kim, K.B.

Hanyang University: Maeng, S.C. and Shin, D.H.

Inha University: Hwang, S.K. and Lee, C.H.

Kangwon National University: Kim, S.H.

Korea Advanced Institute of Science & Technology: Hong, S.H., Nam, S.W. and Wee, D.M.

Kyungpook National University: Cho, H.K. and Kim, D.U.

Pohang Institute of Science & Technology: Chang, Y.W., Kim, D.H., Kim, K.Y., Kim, N.J., Lee, S., Lee, C.S. and Park, C.G.

Pusan National University: Cho, K.M.

Seoul National University: Shin, K.S.

Sungkyunkwan University: Han, J.G.